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THE VERTICAL STRATIFICATION OF BIRDS IN MIXED SPECIES FLOCKS AT PARAMBIKULAM, SOUTH INDIA: A COMPARISON BETWEEN TWO HABITATS[1]

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Key words: Mixed avian foraging flocks, mixed hunting party, Parambikulam, insectivorous flocks, vertical stratification, moist deciduous forest, teak plantation

The vertical stratification of mixed species flocks of birds was compared between moist deciduous forest and teak plantations at Parambikulam, South India. The foraging height, number of species, number of individuals, foraging substrate, and foraging manoeuvre were noted using five minute scan samples. The mean foraging heights of all species of birds were significantly different between the two habitats. The foraging height of drongos and minivets was higher in moist deciduous forest compared to teak plantations. There was also a shift by a few birds in the use of branches as a substrate in moist deciduous forest, to twigs in teak plantations, but no such trend was seen in the use of foraging manoeuvre. A long-term study is suggested for a deeper understanding of the behaviour of these flocks.

Introduction

Interspecific or mixed-species bird flocks are a widely occurring phenomenon that has attracted the attention of biologists for more than a century (Bates 1863). A mixed-species flock has been defined as "any group of two or more birds whose formation depends upon positive responses by individuals to members of their own or other species" (Morse 1970). Mixed-species flocks can be of many types (Morse 1977, Powell 1989) from small to large, composed of a few to many species, the species composition being consistent or variable, the number of individuals per species may be even or markedly uneven; the associations of the component individuals may be ephemeral, enduring only a few minutes or hours, or nearly permanent (Terborgh 1990).

Over a century of work on mixed-species flocks, various aspects have been studied. The two major hypotheses to explain the formation of mixed-species flocks (MSF) are: 1) feeding enhancement and 2) predator avoidance. Feeding advantages can be obtained in various ways. Some birds in mixed species flocks may capture insects that the members, as a whole, flush during their movement (Winterbottom 1943, Morse 1970). Birds in mixed-species flocks minimize duplication of effort by not searching for food in places already searched (Morse 1977). They are also able to exploit food resources otherwise not accessible, by copying the activities of others (Krebs 1973) and by social learning

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(Greig-Smith 1978). They avoid predators in various ways (Morse 1977). The detection of the predator is enhanced by the "more eyes hypothesis". Predators also may not be able to single out a prey due to "confusion effect".

The participants of mixed-species flocks have been classified as "nuclear" and "followers" or "attendants" (Greig-Smith 1978). When some species participate in flocks, various adjustments are made in order to reduce inter-specific competition and/or increase in foraging success. Many species increase their foraging success by copying nuclear or other species (Valburg 1992, Eguchi and Yamagishi 1993, Latta and Wunderle 1996).

Although a wealth of information is available on flocks from neotropical and temperate regions, very little is known of paleotropical flocks, especially from Asia (Jepson 1987). Studies of Asian flocks are restricted to Japan (Ogasawara 1965), Sarawak (Croxall 1976), Burma (Stanford 1947) and India (MacDonald and Henderson 1977, Vijayan 1989, Pramod *pers. comm.*). The flocks of the Western Ghats, India are very poorly understood, with information only from Vijayan (1984), Vijayan (1989) and Pramod (*pers. comm.*). While Vijayan (1984) demonstrated the shift in the use of vertical strata in three species of drongos in each others' presence, Pramod (*pers. comm.*) showed that the flocks in Silent Valley preferentially used the undergrowth and canopy, and characterised the species of 45 flocks into 'leading' and 'following' based on vocalisation.

It has also been found that the foraging height of some birds changes when they are present in a flock (Croxal 1976, MacDonald and Henderson 1977, Eguchi and Yamagishi 1993, Herrera 1979, Jones 1979, Latta and Wunderle 1996). However, there is hardly any information on the stratification of all birds in a flock, which may be a critical factor in determining various aspects of flocks, like inter-specific competition and the maximum number of birds and/or species that can be present in a flock. The habitat structure might also play an important role in the stratification of the flocks. In order to test these hypotheses, this study was undertaken at Parambikulam in Kerala, which has a large section of teak plantations and moist deciduous forests with no information available on the mixed species flocks inhabiting them.

The specific objectives of this study were:

1. To examine whether there exists any difference in the vertical stratification of birds in mixed-species flocks of two different habitats; teak plantation and moist deciduous forest.
2. To examine the probable causes of the difference in vertical stratification.

Study Area

Parambikulam Wildlife Sanctuary (76° 35'-76° 50' E and 10° 20'-10° 26' N), Western Ghats, Kerala is spread over 398 sq. km. It is a wide valley between the Nelliampathy hill ranges to the north and the Anamalais to the south.

The intensive study area consisted of valleys such as Tunacadavu, Tellickal and Parambikulam, with Parambikulam Valley being the largest in the Sanctuary.

The average annual rainfall is 1,723 mm, varying between 1,178 and 2,268 mm. The maximum temperature fluctuates between 24° and 33° C and the minimum between 20° and 25° C. February to April are the hottest months with low relative humidity.

Vegetation

The sanctuary exhibits a mosaic of vegetation, broadly classified based on Champion and Seth (1968) into Southern Tropical Wet Evergreen, Southern Tropical Semi-evergreen, Southern Tropical Moist Deciduous and Southern Tropical Dry Deciduous (Vairavel 1998).

Moist Deciduous Forests

Moist Deciduous Forests occur between 400-1,000 m elevation covering almost 60 sq. km in the Sanctuary. The top canopy remains leafless between March and May. Most teak plantations were raised after clear felling these forests.

Teak plantations

Teak plantations cover an area of *c.*100 sq. km. The stands are of different ages, planted between 1916 and 1982 (Vairavel 1998). The undergrowth in many plantations has been cleared for various purposes.

Methodology

Mixed-species flock

A reconnaissance of the area was done to identify different trek paths and trails to be used. A mixed-species foraging flock was identified after verifying the sighting for two minutes. Five-minute scan samples were made on each flock; a maximum of three such observations were taken with two minute intervals (Altmann 1974) from the time of flock identification.

Different trails and paths were followed every day in order to obtain sufficient replicates. However, parts of a few trails might have been walked more than once. The foraging height of each individual bird, substrate used (trunk, branch, twig, foliage and ground), foraging manoeuvre exhibited (broadly classified under fly-catching, gleaning, probing and flycatcher-gleaning), and number of species and number of conspecifics were recorded. Occurrences of aggressive behaviour and individuals closely following other individuals were noted.

Vegetation

Ten 10 m x 10 m plots were laid in both teak plantations and moist deciduous forests. Plots were laid alternately at 15 m to the right and left of the trail, at 100m intervals. In every plot, the number of trees present (>10 cm gbh), the maximum height and gbh of every tree were recorded. For each tree, the height of the first twig and the first branch present were noted.

Presence or absence of foliage on a tree was noted every 2 m, from 2 m to the maximum height of the tree. In order to quantify the shrub or undergrowth, every 10 m x 10 m quadrate was divided into 25 cells measuring 2 m x 2 m. The maximum height of the shrub/undergrowth in each such cell was noted.

Analysis

All analysis was done using SPSS version 7.5.

Results and Discussion

One hundred flocks were spotted in the teak plantation and 188 observations (of five minute scans) were made on them. For the same number of flocks spotted in the Moist Deciduous Forest, 178 observations were made. Since the number of observations for each flock varied from one to three, each observation was taken as a unit for analysis. A total number of 61 species of birds and two species of primates were found in Moist Deciduous Forest and 57 species of birds and one species of giant squirrel (*Ratufa indica*) was found in teak plantations (Appendix 1). It has to be noted that different species of warblers and flower-peckers were not recorded to the species level due to difficulty in identification. Spending more time to identify these species could have resulted in missing other species. Common golden-backed woodpecker *Dinopium javanense* and lesser golden-backed woodpecker *Dinopium benghalense* were together considered as "golden-backed woodpecker" due to unclear identifications in the initial stages of the fieldwork. However, since they work as a guild (gleaners and probers), the problem in sampling may not be very significant in a mixed species foraging flock.

Of all the birds in both habitats (Appendix 1), only 10 species (Table 1) were common (>11%) to both the habitats. The foraging heights of all birds in both the habitats were compared using t-test and showed that the birds forage significantly higher in Moist Deciduous Forests (P=0.000) (Table 2). The data on 10 common species was used for analysis of vertical stratification. There seemed to be a definite trend in the vertical stratification of birds. Forty-five different combinations of the ten common species were analysed for variability in foraging height using paired sample t-test for the various combinations (Table 3). Most combinations of species (97%) showed that mutually exclusive foraging heights are used by most species except the following: white-bellied drongo *Dicrurus caerulescens* occupied similar heights as the bronzed drongo *Dicrurus aeneus* (P=0.346) and velvet-fronted nuthatch *Sitta frontalis* (P=0.803); large woodshrike *Tephrodornis gularis* had foraging heights similar to scarlet minivet *Pericrocotus flammeus* (P=0.406) and white-bellied drongo (P=0.611); great tit *Parus major* shared its foraging height with the bronzed drongo (P=0.813) (Table 3). The greater racket-tailed drongo *Dicrurus paradiseus* was found in the lower parts of both the habitats. Bronzed drongo preferred a higher stratum than the greater racket-tailed drongo. Such vertical stratification has also been observed by Vijayan (1984) at Thekkady. The reason for the same was hypothesised to be the avoidance of inter-specific competition. The minivets were found from

Table 1: Ten common species in the flocks of Moist Deciduous Forest and Teak Plantation

Species	Abbreviation
Great racket-tailed drongo	RTD
Bronzed drongo	BDR
White-bellied drongo	WBD
Scarlet minivet	SCM
Small minivet	SMM
Large woodshrike	LWS
Great tit	GTT
Jungle babbler	JBB
Golden-backed woodpeckers	GBW
Velvet-fronted nuthatch	VFN

Table 2: Comparison of foraging heights of all birds in Teak Plantation and Moist Deciduous Forest

Habitat	N	Mean	S.D	S.E	P
Teak	1910	7.41	5.13	0.12	0.000
MDF	1528	8.86	5.62	0.14	

Table 3: Paired t-test p values for difference in height of ten common species of birds in Teak Plantation and Moist Deciduous Forest

	BDR	WBD	SCM	SMM	LWS	VFN	JBB	GTT	GBW
RTD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0094
BDR		**0.3461**	0.0000	0.0000	0.0011	0.0000	0.0000	**0.8133**	0.1001
WBD			0.0617	0.0000	**0.6115**	**0.8032**	0.0000	0.0036	0.0003
SCM				0.0140	**0.4069**	0.0009	0.0000	0.0002	0.0000
SMM					0.0000	0.0000	0.0000	0.0033	0.0000
LWS						0.0253	0.0000	0.0429	0.0000
VFN							0.0000	**0.1656**	0.0000
JBB								0.0000	0.0000
GTT									0.0292

Values in bold are not significant

middle to higher zone, while the jungle babbler *Turdoides striatus* seemed to prefer the undergrowth and ground. The other gleaners and probers (golden-backed woodpeckers, great tit, velvet-fronted nuthatch and large wood shrike) were found in varying heights in the middle strata.

Significant differences in foraging height were found in five species (Table 4) when the foraging heights of each of the 10 common species were compared between the two habitats. Various factors were considered for the difference in foraging height.

Height of trees

If the height of the trees in one habitat is greater than the height of trees in the other, it could naturally cause an increase in the foraging height of the birds. It must be noted that the teak plantations in Parambikulam are fairly old: the trees have undergone silvicultural thinning and the surviving trees are considerably tall. The analysis of tree heights in the two habitats revealed that teak plantation trees were taller than the moist deciduous forest trees (P=0.017) (Table 5). Thus, if the birds' choice of foraging

Table 4: Comparison of mean heights between two habitats of ten commom species (t-test)

Species	Habitat	Mean height (m)	N	Std. Deviation	Std. Error	t-value	*p*
RTD	MDF	6.51	108	3.86	0.37	2.1548	0.0334
	Teak	5.42	108	3.36	0.32		
BDR	MDF	9.44	217	4.72	0.32	3.7180	0.0002
	Teak	7.85	217	3.67	0.25		
WBD	MDF	10.17	29	5.68	1.05	3.0203	0.0053
	Teak	5.93	29	4.05	0.75		
SCM	MDF	11.96	221	5.43	0.37	2.2537	0.0252
	Teak	10.82	221	5.14	0.35		
SMM	MDF	12.15	62	4.41	0.56	-0.1697	0.8658
	Teak	12.32	62	5.31	0.67		
LWS	MDF	9.87	46	4.94	0.73	0.1990	0.8430
	Teak	9.67	46	4.44	0.65		
VFN	MDF	9.38	64	4.24	0.53	2.0770	0.0419
	Teak	8.00	64	3.18	0.40		
JBB	MDF	2.07	119	2.10	0.19	2.2630	0.0254
	Teak	1.51	119	2.11	0.19		
GTT	MDF	7.64	22	5.18	1.10	-1.5655	0.1324
	Teak	9.64	22	4.36	0.93		
GBW	MDF	7.26	76	4.32	0.50	1.1147	0.2685
	Teak	6.41	76	4.00	0.46		

Table 5: Comparison of habitat parameters between Moist Deciduous Forest and Teak Plantation

Habitat	Parameter	Mean height (m)	N	S.D	S.E	t-value	*p*
MDF	height	19.57	10	2.89	0.91	-2.9290	0.017*
Teak	height	24.9	10	3.6	1.14		
MDF	branch	7.28	10	1.86	0.59	-3.2950	0.009*
Teak	branch	10.69	10	2.55	0.80		
MDF	twig	6.47	6	2.9	1.21	-0.8600	0.9350
Teak	twig	6.69	6	3.3	1.38		
MDF	undergrowth	1.806	10	0.85	0.27	6.4496	0.0001*
Teak	undergrowth	0.285	10	0.19	0.06		

* significant

height was due to an increase in the height of trees in the two different habitats, a reverse trend (lower foraging height in Moist Deciduous Forest) should have been seen. However, the foraging height of all birds was greater in the Moist Deciduous Forests. Hence, tree height does not appear to contribute directly to the foraging height of birds. However, the sample size for the habitat parameters data is small (N=10 in each habitat) and the result may be biased.

Foraging manoeuvre

The drongo used sallying as its foraging manoeuvre on most occasions (96%, Table 6) (X^2, p=0.000). It has been said that foraging manoeuvre of a species could change depending on the kind of prey that is pursued. This difference in prey selection could also cause an increase in foraging height of the birds if there is a variation in prey availability. The foraging manoeuvre, however, did not seem to vary and most birds followed the same method of prey capture in both the habitats. Pinkowski (1979) in his study of *Sialia* sp. suggested that sallying might be a more expensive foraging manoeuvre than gleaning or flycatcher-gleaning. However, flycatcher-gleaning and gleaning involve active searching for prey, and when the drongos (the predominantly sallying species in this study) form part of mixed species foraging flocks, they wait for the prey to be flushed by the gleaners. With abundant aerial prey, sallying might be bio-energetically more viable. Pinkowski (1979), in his model, proposed that if an aerial prey is visible, it would be the first choice for the fly-

Table 6: Percentage use of foraging manoeuvre by ten common species in the two habitats

Species	Habitat	Gleaning	Sallying	Fly-catcher gleaning	Probing
RTD	teak	2.78	94.44	2.78	
	MDF	2.78	96.30		0.93
BDR	teak	1.27	98.10	0.63	
	MDF		100.00		
WBD	teak	1.47	95.59	2.94	
	MDF	6.90	93.10		
SCM	teak	93.25	0.42	5.91	0.42
	MDF	97.29	1.36	1.36	
SMM	teak	96.77		3.23	
	MDF	87.10	4.84	8.06	
LWS	teak	95.65		4.35	
	MDF	93.02	4.65	2.33	
VFN	teak			0.77	99.23
	MDF	1.56	1.56		96.88
JBB	teak	50.00	0.71		49.29
	MDF	61.34			38.66
GTT	teak	100.00			
	MDF	100.00			
GBW	teak				100.00
	MDF				100.00

catching species. No significant difference in foraging behaviour was seen in different species between the two habitats. This could be because there is no functional difference in the flocks of both the habitats; i.e. gleaners flush insects and sallying species follow, irrespective of the habitat that the flock is in. Drongos at Thekkady preferred sallying when in the presence of other birds, but flycatcher-gleaning when feeding solitarily (Vijayan 1984). This further corroborates the choice of sallying as a preferred foraging manoeuvre for the drongos in mixed species flocks. Studies by Latta and Wunderle (1996) and Jones (1977) also show that shifts in the foraging manoeuvre of birds occur when feeding in flocks compared to feeding solitarily, possibly due to inter-specific competition. However, there is no data on this aspect in this study.

Substrate characters and use

The availability of suitable substrate was thought to be a limiting factor in vertical stratification of a species. A species' preference for a particular substrate and its availability at a higher stratum in moist deciduous forest could cause an increase in the foraging height. It was found that many species showed a strong preference for a particular substrate. For the sallying drongos whose prey capture location is air, the substrate is merely a perching site, whereas for gleaners it is also the location of prey capture. The drongos preferred twigs (X^2, P=0.000) compared to other substrates (Table 7). However, the height of primary twig in the two habitats did not seem to show any significant difference (P=0.93) (Table 5) and thus, the change in foraging height of the drongos might not be due to the change in height of its preferred substrate, twigs. In Teak Plantations, there was an increased use of branches by the drongos as a substrate, compared to that in the Moist Deciduous Forest, but the percentage of usage

Table 7: Percentage use of substrate by ten common species in the two habitats

Species	Habitat	Foliage	Twig	Branch	Trunk	Ground/ undergrowth
RTD	teak	0.69	84.03	14.58	0.00	0.69
	MDF	0.00	94.44	2.78	0.00	2.78
BDR	teak	0.63	86.03	13.33	0.00	0.00
	MDF	0.92	96.77	2.30	0.00	0.00
WBD	teak	0.00	69.12	30.88	0.00	0.00
	MDF	0.00	93.10	6.90	0.00	0.00
SCM	teak	87.34	7.17	5.06	0.42	0.00
	MDF	92.31	5.43	0.90	0.00	1.36
SMM	teak	87.10	8.06	4.84	0.00	0.00
	MDF	95.16	3.23	1.61	0.00	0.00
LWS	teak	4.35	76.09	19.57	0.00	0.00
	MDF	1.16	65.12	32.56	0.00	1.16
VFN	teak	0.00	30.77	36.92	32.31	0.00
	MDF	0.00	28.13	32.81	39.06	0.00
JBB	teak	1.79	18.57	20.36	3.57	55.71
	MDF	0.84	20.17	22.69	10.92	45.38
GTT	teak	27.27	63.64	9.09	0.00	0.00
	MDF	57.14	34.29	2.86	0.00	5.71
GBW	teak	0.00	2.55	26.75	70.06	0.64
	MDF	0.00	3.95	31.58	64.47	0.00

(14.58%) (Table 7) was not high. However, the height of primary branching is greater in teak plantations (P=0.009) (Table 5) and this shift in substrate does not seem to have influenced the foraging height of the drongos. This indicates that the drongos shifted their foraging perch to higher twigs in the Moist Deciduous Forest. One of the reasons for such a shift could be the greater abundance of twigs at a higher stratum in moist deciduous forest than in Teak Plantation, but habitat data are inadequate to draw a conclusion in this regard. The drongos were also found to be following the gleaning species most of the time (e.g. bronzed drongo followed scarlet minivet and greater racket-tailed drongo followed golden-backed woodpeckers) (Robin 2000). There appeared to be an increase in the foraging height of the scarlet minivet (P=0.02) and this could have caused an increase in the foraging height of the bronzed drongo (P=0.03). The increase in foraging height of the scarlet minivet could be due to the availability of suitable substrate at a higher stratum in the Moist Deciduous Forest. However, there seemed to be no significant change in the foraging height of the small minivet *Pericrocotus cinnamomeus* between the two habitats (P=0.86) and a difference, if any, could be due to inter-specific competition as they are conspecifics. The foraging height of only the great tit showed a decrease in the Moist Deciduous Forest (P=0.13) while the large woodshrike showed no significant change (P=0.86) (Table 4).

There seemed to be no significant change in substrate use of minivets, nuthatch, great tit and golden-backed woodpeckers (Table 7). The jungle babbler used undergrowth and ground more than any other substrate in both the habitats (X^2, P=0.000). However, there seemed to be a higher percentage of ground/undergrowth utilisation in Teak Plantation and the utilisation of trunk in Teak Plantation was lower than in Moist Deciduous Forest (Table 7). The high percentage of use of ground/undergrowth could be because Teak Plantation had less undergrowth cover than Moist Deciduous Forest (X^2, P=0.000). Hence, the visibility of the babblers could have been higher in Teak Plantations. The babblers might also have preferred to feed on open ground than in denser undergrowth, as visibility of insects might be higher. Since "undergrowth/ground" was considered as a single substrate, quantitative information on whether ground is preferred to undergrowth is not available. Higher utilisation of trunk in Moist Deciduous Forest could be due to difference in prey availability. However, more data are required to confirm this. There seemed to be an increase in the height of undergrowth in Moist Deciduous Forest (P=0.0001) (Table 5) and the preference of jungle babbler towards undergrowth/ground could have resulted in an increase in its foraging height (P=0.025) (Table 4) in Moist Deciduous Forest.

The velvet-fronted nuthatch used branches, trunk and twigs almost evenly but the use of branches seemed to be higher in Teak Plantations (Table 7). Since the primary branching was found lower in Teak Plantations (Table 5), the increase in height in Moist Deciduous Forest could be due to its choice of higher parts of twigs, trunk and branches other than primary branches.

The shift in the substrate could also be due to inter-specific competition as found in Alatalo's (1981) study where great tits and gold crests shifted their foraging sites depending on the presence or absence of each other.

Other possible reasons

The availability of food in a higher area in Moist Deciduous Forest could be one of the possible reasons for an increase in the foraging height of most birds in that habitat. However, this aspect was not studied. Inter-specific competition and niche separation could be another reason for an increase in foraging height. However, most of the species occurring in Moist

Deciduous Forest were found in Teak Plantations as well, and a shift in foraging height in all birds due to this factor is unlikely. The presence of most birds in a higher stratum could also be due to the phenological phase of the trees in the habitat during the study period. The Moist Deciduous Forests were sampled in February-March when leaf fall had commenced, whereas Teak Plantation was sampled in December-January, before the leaf-fall. Pinowski (1979) states that dead and leafless branches might offer an unobstructed view for searching prey. He found eastern bluebirds using higher perches in summer than in spring. The birds could thus have shifted to a higher stratum in the season when leaf-fall occurred. However, sampling of the mixed species flocks in the two habitats in the same season could have given a more accurate idea of the same.

The study reveals that not only is there a clear vertical stratification in the birds in mixed species flocks, but also a difference in the usage of height between the two habitats. However, the factors influencing the shift in foraging height could be any of the above or could be a combination of various factors. Different species may have different factors affecting their vertical stratification. Carefully designed long-term studies should be carried out considering various seasonal changes, to determine these causes. Quantification of prey base, though difficult in the field, has to be done in order to understand prey availability and response of different species to it. Colour banding individual birds might facilitate identification of individuals and would result in greater understanding of the dynamics of the flocks.

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Appendix 1: Percentage occurrence of birds and *mammals in flocks of two habitats

Species	Scientific name	% Occurrence Teak	% Occurrence MDF
Bronzed drongo	*Dicrurus aeneus*	78.19	66.85
Greater racket-tailed drongo	*Dicrurus paradiseus*	61.70	51.69
Scarlet minivet	*Pericrocotus flammeus*	48.94	51.12
Golden-backed woodpeckers	*Dinopium* sp.	45.21	30.90
Large woodshrike	*Tephrodornis gularis*	11.17	24.72
Velvet-fronted nuthatch	*Sitta frontalis*	40.96	24.16
Grey-headed starling	*Sturnus malabaricus*	7.98	19.66
White-cheeked barbet	*Megalaima viridis*	1.60	15.73
Small minivet	*Pericrocotus cinnamomeus*	15.96	15.73
Great tit	*Parus major*	11.17	15.17
White-bellied drongo	*Dicrurus caerulescens*	34.57	14.61
Jungle babbler	*Turdoides striatus*	26.60	14.61
Indian treepie	*Dendrocitta vagabunda*	10.11	12.92
Red-whiskered bulbul	*Pycnonotus jocosus*	2.66	11.24
Ashy drongo	*Dicrurus leucophaeus*	15.43	10.67
Red-vented bulbul	*Pycnonotus cafer*	7.45	10.67
Gold-fronted chloropsis	*Chloropsis aurifrons*	6.91	10.67
Eurasian golden oriole	*Oriolus oriolus*	3.19	10.67
Oriental magpie-robin	*Copsychus saularis*	1.06	8.99
Brown-capped pygmy woodpecker	*Dendrocopos nanus*	13.30	8.99

Appendix 1 (*contd.*): Percentage occurrence of birds and *mammals in flocks of two habitats

Species	Scientific name	% Occurrence Teak	% Occurrence MDF
Plum-headed parakeet	*Psittacula cyanocephala*	4.79	8.99
Black-headed oriole	*Oriolus xanthornus*	6.91	8.43
White-bellied treepie	*Dendrocitta leucogastra*	6.91	7.30
Warblers	(various genera)	5.85	7.30
Iora	*Aegithina tiphia*	3.72	6.74
Brown-eared bulbul	*Iole indica*	1.60	6.18
Small yellow-naped woodpecker	*Picus chlorolophus*	9.57	6.18
Asian paradise-flycatcher	*Terpsiphone paradisii*	9.04	5.62
Common myna	*Acridotheres tristis*	11.70	5.06
Asian brown flycatcher	*Muscicapa dauurica*	2.66	3.37
Tickell's blue-flycatcher	*Cyornis tickelliae*	0.00	3.37
Yellow-fronted pied woodpecker	*Dendroscopus mahrattensis*	1.60	3.37
Large green-billed malkoha	*Phaenicopterus tristis*	1.60	3.37
Three striped palm squirrel	***Funambulus palmarum***	**3.19**	**3.37**
Flowerpeckers	*Dicaeum* sp.	3.19	2.81
Common woodshrike	*Tephrodornis pondicerianus*	2.13	2.81
Spotted dove	*Streptopelia chinensis*	6.38	2.81
Jungle owlet	*Glaucidium radiatum*	0.53	2.25
Large cuckoo shrike	*Coracina macei*	1.60	1.69
Heart-spotted woodpecker	*Hemicircus canente*	1.06	1.69
Common hoopoe	*Upupa epops*	1.06	1.69
Pied flycatcher-shrike	*Hemipus picatus*	1.06	1.69
Ruby-throated bulbul	*Pycnonotus melanicterus gularis*	0.00	1.69
Drongo cuckoo	*Surniculus lugubrius*	0.00	1.12
Bonnet macaque	***Macaca radiata***	**0.00**	**1.12**
Blue-throated flycatcher	*Cyornis rubeculoides*	0.00	1.12
Chestnut-headed bee-eater	*Merops leschenaulti*	0.00	1.12
Asian fairy-bluebird	*Irena puella*	4.79	0.56
Indian rufous babbler	*Turdoides subrufus*	0.00	0.56
Black-naped monarch-flycatcher	*Hypothymis azurea*	0.53	0.56
Little spiderhunter	*Arachnothera longirostra*	1.06	0.56
Black-naped oriole	*Oriolus chinensis*	1.06	0.56
White-breasted kingfisher	*Halcyon smyrnensis*	2.13	0.56
Greater coucal	*Centropus sinensis*	1.60	0.56
Black bulbul	*Hypsipetus leucocephalus*	0.00	0.56
Nilgiri langur	***Presbytis johni***	**0.00**	**0.56**
Black-headed babbler	*Rhopocichla atriceps*	0.00	0.56
White-rumped munia	*Lonchura striata*	0.00	0.56
Malabar whistling-thrush	*Myiophonus horsfieldii*	0.00	0.56
Purple sunbird	*Nectarinia asiatica*	2.13	0.00
Brown shrike	*Lanius cristatus*	2.13	0.00
Rufous woodpecker	*Celeus brachyurus*	0.53	0.00
Grey junglefowl	*Gallus sonneratii*	3.19	0.00
Common tailorbird	*Orthotomus sutorius*	1.06	0.00
Asian koel	*Eudynamys scolopacea*	0.53	0.00
Orange headed thrush	*Zoothera citrina*	1.06	0.00
Small sunbird	*Nectarinia minima*	1.06	0.00
Jungle crow	*Corvus macrorhynchos*	1.06	0.00
Malabar giant squirrel	***Ratufa indica***	**0.53**	**0.00**

* Mammals in bold letters